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LORD KELVIN

AS PROFESSOR IN THE OLD COLLEGE OF GLASGOW

BY

DAVID MURRAY,

M.A., LL.D.

GLASGOW

MACLEHOSE, JACKSON AND CO.

PUBLISHERS TO THE UNIVERSITY

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THIS paper is reprinted from 'Memories of the Old College of Glasgow, Some Chapters in the History of the University,' which is at present passing through the Press. References on pp. 14, 16, *and elsewhere, relate to the earlier portion of that book. The portrait of Lord Kelvin in* 1870, *which forms the frontispiece, is reproduced by permission of Messrs. Macmillan and Company Limited.*

14*th June*, 1924

LORD KELVIN

WILLIAM THOMSON, Lord Kelvin, (1824-1907) was a son of James Thomson, Professor of Mathematics in the University of Glasgow, and was a student here (1834-41), after which he proceeded to Cambridge where he was second wrangler and Smith's prizeman in 1843. He returned to Glasgow in 1846 as Professor of Natural Philosophy in succession to William Meikleham, LL.D., and held the chair until 1899.

Lord Kelvin has been described as the foremost Cambridge man of science since Isaac Newton and world-renowned as a mathematician and a physicist. He is the most distinguished amongst the professors of the University of Glasgow. On the other hand it has been said that he failed as a professor, that is, as a teacher. This depends on what is meant by a " teacher." Sir William Gairdner used to tell his students that it was his duty as Professor of Medicine to instruct them in the principles of his subject, but not to coach them for examinations, and that if they looked for coaching they must go elsewhere. Lord Kelvin, or as he was in my day, William Thomson, was certainly not a coach, but he was an enthusiastic and inspiring teacher ; he aroused and sustained the intelligent interest of his students and gave them a broad and comprehensive view of many branches of physics and awakened in them a love for the subject. No one could listen to him without being imbued with his spirit and

being borne along the path he was travelling. Examinations of the present type, except for the degree of M.A., were then unknown. To have converted Professor Thomson into a grinder to cram students for examinations, to coach for honours, to train apprentices in laboratory processes, to set reams of examination papers and read the answers would have blighted his genius and would have ruined him as a scientist.

There was no Faculty of Science in my time and it did not come into being until thirty years afterwards. Natural Philosophy was then purely an Arts subject and was regarded as an instrument for what Lord Bacon terms, " that improvement of the understanding which results from the cultivation of natural knowledge, and that elevation of mind which flows from the contemplation of the order of the universe," and was on the same footing as Logic and Moral Philosophy ; it was not treated as part of a scheme for the training of specialists. This was certainly Professor Thomson's view, who held that Greek, as an instrument of culture and of mental discipline, was an essential part of the Arts course and that every scientific man should have a fair acquaintance with it. It is scarcely possible, he once remarked, to " over-estimate the life-long good gift presented to a scientific student by Universities in giving something of the *Literæ humaniores* to all who can and will take it." The Arts curriculum of that day was intended for culture only, not as providing something which was to have a commercial value ; the idea that any of its subjects could be made the foundation of industrial training in science as now understood and that students could specialise in such a subject had not then been contemplated. Sir Robert Peel, in addressing the students in 1838, explained that the scheme of the Scottish Universities was planned in conformity with the suggestion of Lord Bacon—that learning should be made subservient to action—a system that does not partake of a professional character.

Professor Thomson, in accordance with the statutes of the University, met his class two hours on five days of the week during a session of six months, and a large portion of his time was free

to carry on his own investigations. Things changed when the Universities Act of 1858 came into full operation some years after, and if the position had been in 1846 what it now is, William Thomson would probably not have accepted the chair. When appointed, and for about thirty years afterwards, he was able to treat his subject in the manner he considered profitable for his students. These, he said, " were the palmy days of Natural Philosophy in the University of Glasgow—the pre-Commissional days."

Lord Kelvin possessed the gift of lucid exposition in ordinary language remarkably free from technicalities. Occasionally he got outwith the range of the majority of his class; but there was no obscurity in his statement, it was simply beyond their grasp. In such cases he was borne on by his desire to complete the explanation of some particular problem and to carry it to what he considered to be its logical conclusion. At the same time he never overlooked elementary principles, and these he repeated and again enunciated, as they emerged in the discussion of almost every topic he touched upon. He dictated a long series of formulas and propositions, expressing the hope that his students would never forget these whatever might be their pursuits in after life.

He had no syllabus of lectures and used no notes in lecturing. He had his subject clearly before him and dealt with it in logical order. He was not dictating a manual of Natural Philosophy to his students, and treated some parts of the subject with greater fulness than others, prominence being given to what he judged appropriate at the time. He considered that it was unnecessary for him to teach what could be got in an ordinary text-book and that his province was to supplement this. When I was in his class he arranged with John Ferguson—afterwards Professor of Chemistry —to prepare an elementary treatise on Dynamics from the notes of lectures the latter had taken as a student. This was placed in our hands; we were expected to study it and we were examined upon it, as if it had been given in the form of class lectures. I remember Ferguson coming up to the Natural Philosophy class-room

for directions on various points. The sheets were handed to us damp as they came from the printing press, and were subsequently issued in book form.

Astronomy, as we were often reminded, was one of the subjects allotted to the Professor of Natural Philosophy and was included in the examination for the degree of M.A. Lord Kelvin, however, frankly told us that we could learn quite as much from a text-book as from lectures, and prescribed two or three books, any one of which we might read. In this way the Professor found time to deal very thoroughly with general physics and with special branches such as heat and electricity. It was, however, rather hard upon the students ; they had to work privately at Dynamics and at the same time keep pace with the Professor's lectures, to say nothing of their reading on Astronomy. Fortunately for us his rate of speed was occasionally interrupted. A thunderstorm, for instance, was a godsend. The electrometers were all at work, observations taken, explanations given and a running commentary made, conjectures thrown out, and the whole treated as an experiment specially designed to illustrate some point which had been touched upon in recent lectures. It was not an observation of ascertained phenomena, but an opportunity for collecting fresh data for further investigation. Everything which was observed was explained, discussed and commented on, and this commentary might be continued on the next day or even longer as fresh suggestions occurred. The Professor was always on the hunt for information ; his students on such occasions became partners in the quest. The experience was invaluable and gave them a living interest in science. It was a practical lesson in observation and was both amusing and instructive. The interruption also gave the class an opportunity for overtaking the ordinary lectures, which generally contained more matter than the students found it easy to deal with.

An unusual occurrence was always welcomed as matter for investigation. One morning the professor arrived a few minutes late. He apologised and explained that the College clock had stopped and that he had gone to ascertain the cause. He had

recently devised a plan for controlling the clock from the Observatory by means of a current of electricity, and was much interested in it. He found that a carpenter who had been at work in the tower had dropped a wood-chip which had fallen between two wheels and stopped them. He added that notwithstanding the stoppage of the mechanism the pendulum was swinging as usual and was being kept in motion by the current, and this he explained at some length. Next day the students found that a clock dial with pendulum, but without mainspring or weight, operated by an electric current, had been erected in the class-room. Motion was given to the pendulum by hand ; its rate was marked ; and for the next six weeks—while the session lasted—there was no perceptible abatement in the swing.

When the professor got beyond his class, he recognised this and would pause and say that they must assume certain propositions or allow him to work out certain calculations. It is said that his mathematics were beyond his hearers. Perhaps they were. He was a superb mathematician, but he always subordinated mathematics to physics. After explaining a subject, one of his favourite expressions was " Now let us put it into the ' mathematical mill ' and test it," and if the operation was abstruse he was at pains to explain it. He no doubt passed from one topic to another with great rapidity, but he did so because the second illustrated or confirmed the principle he had been explaining. He was never dull, never trivial, never commonplace. His students never lost interest in his lectures. He knew when he was side-tracked, and in the end always came back to the main line at the point at which he had diverged from it.

He dispensed with the professorial gown after his introductory lecture and stood when lecturing, eager, alert and animated like a runner waiting for the starting signal. He spoke somewhat rapidly, but clearly and distinctly. Off-hand speaking is apt to be loose and vague. This was never so with William Thomson. He took great pains to be accurate and precise in his expressions, and sometimes paused to explain the language he was using and why

one word or phrase was employed rather than another. He was sometimes discursive, but he was not irrelevant or confused. He was punctual in the discharge of his duties ; he never missed a meeting of his class, and the whole of each hour was occupied with work. I see from my Notes that in the session 1862-63 we had amongst others at the 9 o'clock hour forty-eight lectures on the general portion of the course and forty-one on Electricity and Magnetism, and at the 11 o'clock hour sixty lectures on the mathematical principles of Kinematics.

He was always in earnest, and when dealing with great problems spoke with the fervour of a missionary charged with a weighty message. It was a strange sight to watch him as he became more and more eager in his exposition ; a light seemed to play upon his forehead like an emanation. I have watched Gladstone in his most passionate outbursts, but although the struggle of a great soul was to be seen in every feature it never irradiated his brow as it did that of William Thomson. It was a rare privilege to witness the movements of the mind expressed in feature and in gesture, to behold the living spirit visibly present. His was a unique personality ; genius of the highest order coupled with sound judgment and practical ability ; passionate earnestness and deep reverence ; a modesty and simplicity of character seldom met with.

An important element in his method of teaching was that it was always up to date. Each topic was presented in its latest phase, and in so presenting it he often carried it further than had already been done and made suggestions beyond those that had been published. To preserve a record of what he taught each session and of such suggestions he gave a prize each year for the best set of notes taken in his class, and from these he was able to state if necessary that he publicly taught a certain doctrine in a particular year. What became of this series of notebooks I do not know, but they contained a valuable record of the development of Thomson's views over a long period.

The reading of written lectures may have advantages, but it tends

to make the teaching formal and stationary. One of Thomson's brethren of later date who used this method observed to a student, " Mr. Snodgrass, I do not see you taking notes." " No, Sir," replied the student in an injured tone, " I have my father's notes and find them quite accurate."

It has been said that some of the students could not follow Thomson. That may be so ; there are students in every class who have only a dim idea of what is being put before them even by the most skilful teacher, and why should students in Natural Philosophy be an exception ? There never was a better lecturer or a more successful teacher than Robert Buchanan, " Logic Bob," but there were quite as many students in his class who were unable to grasp his meaning as there were in William Thomson's. He had been lecturing on the association of ideas[1] and had a student under examination. " Now, Carole, suppose you were standing upon a bridge looking down upon the water flowing below, what would it suggest to you ? " The professor did not expect anything very recondite—the flight of time, the flowing of the stream of life, or the like. Carolus, however, was puzzled. He stood first on the one foot, then on the other, ruminated and at last ejaculated in stentorian tones " Wat—ter."

If parts of Professor Thomson's lectures were beyond the comprehension of some of his students, this did not apply to examinations. Such examinations were required by the University in all the Philosophy classes. They were oral and frequent. Professor Thomson's examinations were upon *The Elements of Dynamics*, which, as I have explained, we received in weekly instalments, and on his lectures of the few preceding days. The students were called up in turn and examined in the usual way. When a question was not properly or adequately answered it went round the class until the correct answer was obtained. A student, however, was sometimes fogged, and this the professor occasionally failed to apprehend.

[1] Sir William Hamilton commends the aptness of the simile of our old Principal John Major of the association of ideas—the consecution of thought —to a cobbler's bristle and thread : *una notitia aliam trahit, ut seta sutoris filum.* Reid's *Works*, pp. 894, 907.

He was inclined to think that a student wouldn't when he couldn't answer. If, however, he did discover the situation he did not find fault, but sympathetically came to the assistance of the student. If it was his mathematics that were weak the professor turned to the blackboard, wrote down the problem, explained it, then worked it out step by step, commenting on each as he went along until the result was obtained. The whole class had the benefit, and it was very instructive. On the other hand, the answers of another student might show that he had thoroughly mastered the subject. This often touched a responsive note in the professor's mind. He took up the theme, expanded it, showed it in different relations and discussed the general principles involved. These examinations were of the nature of a dialogue between the professor and his students on a subject in which they were mutually interested, and were a great mental stimulus to the students and did much for their intellectual development. There is no other means, says Professor Jardine, " by which a knowledge of the disposition and habits of students can be so well acquired as by a constant intercourse with them in the way of examination." Papers were set weekly for home work. These were handed in and were gone over by the professor, who then handed them back, commenting on any points which had not been adequately answered or which seemed to have been misunderstood. If the misunderstanding was general, he took up the subject and went over it carefully so as to remove misapprehension. In early days he had monthly written examinations in the last four months of the session,[1] but these had been discontinued in my time.

[1] I have the printed class papers for the sessions 1846-47 and 1847-48, and also the Degree examination papers (Glasgow, 1847-48, 8vo). The last question, that set in the paper of 26th April, 1848, is : " State briefly Carnot's principle according to which the motive power of heat must be estimated. Explain a principle according to which from this theory an absolute thermometer scale may be defined." The subject was in Professor Thomson's mind and on the 12th of the same month he read a paper to the Philosophical Society of Glasgow : " On an absolute thermometer scale founded on Carnot's theory of the motive power of heat and calculated from the results of Regnault's experiments on the pressure and latent heat of steam."

In later years when Sir William Thomson, as he then was, had a University assistant and only lectured occasionally, I have heard that students complained that the teaching of the class was inadequate, but of this I know nothing. In so far as it may be correct it is probably attributable to the changes brought about under the Universities Act in the position of the professor and the character of the teaching required.

His lectures in my time were full of information carefully and succinctly stated, and no one who listened to them with ordinary intelligence could fail to have his mind quickened and enlightened, and to carry away such an acquaintance with the principles of Physics as to enable him in after life to follow the problems of science.

My friend, John Y. Buchanan,—afterwards a distinguished chemist, F.R.S., and Lecturer on Geography in the University of Cambridge—was a fellow-student with me in William Thomson's class. He was an excellent mathematician, with a strong bent for science, and greatly enjoyed Thomson's lectures. Buchanan's father at that time lived in Blythswood Square ; I called at his house every morning when passing and we walked to College together and discussed the lecture of the preceding day, and he explained whatever difficulties had occurred to me in writing out my notes or in thinking over or working out the subject that had been dealt with.

I knew Professor Thomson long before I became a student in his class. His brother-in-law, Walter E. Crum, had been my schoolmate at Merchiston and was my fellow-student for a year or two at the University of Glasgow. Between classes we used to go to Professor Thomson's house and toast our toes at his fire, and the professor often looked in and had a chat with us. I also knew him well in after life. One of his peculiarities was that he assumed that the person he was talking to knew quite as much as he did. It was often difficult to keep a conversation going without volunteering an occasional suggestion. When it came Lord Kelvin seized upon it, turned it round and round, looked at it from every angle and with

evident regret decided that it did not advance our discussion. He never showed the slightest annoyance in having been started on a wildgoose chase. He exhibited the same trait as a professor. When examining his class he perhaps put a question to a student which the latter was unable to grapple with. The professor was not perturbed ; he tried again, putting the question in a simpler form, but still beyond the limited capacity of the student ; again in a still more simple way ; again without success ; at last it came to Yes or No ; the unfortunate student said " No " when it should have been Yes ; and in the end said " Yes." " Now, Mr. Macintosh," said the professor, " why could you not have said so at first ; why will you have me drag the information from you, sentence by sentence, clause by clause, nay word by word." He assumed that it was obstinacy on the part of Mr. Macintosh that caused him not to answer straight away ; inability to do so did not occur to him. When a mathematical problem has to be solved the professor writes it on the blackboard and calls on a student to do the work and writes down the various results as the student directs. Lord Kelvin, however, did the work himself. Having set the problem he called upon a student to deal with it who perhaps had no idea of what to do, but was not prepared to confess ignorance. The professor asked for instructions : Multiply, said the student, and the professor did so ; Divide, said the student, and the professor did so, and on it went. I remember Professor Thomson covering a whole blackboard with this useless work all carried out by himself as directed. At last the bewildered student said, " I am afraid, Sir, I do not see where I am going." " Neither do I, Mr. Gillies, you may sit down," and the professor then sponged out all the ridiculous operations he had written down. But while Thomson was exceedingly patient with dull men and seemed to act on the belief that most of his students were on the same plane as himself, he allowed no fooling and was quick to detect any attempt to take liberties with himself. A tall, good-looking young man with an excellent opinion of himself, active in the Conservative Club at election times and afterwards of some

repute as a preacher, when called up for examination attempted to fool the professor by what he considered facetious answers. Thomson turned upon him like a flash and administered a severe reprimand in a few crisp, telling words. The incident was not forgotten by his fellow-students and was associated with him in their minds as long as he was at College and even in after life. Professor Thomson had a very reverent nature, and was shocked by anything savouring of irreverence. One morning during prayer—for all the Arts classes were opened with prayer at the morning hour—a student who had a handful of shredded paper busied himself in placing the stuff on the neck of another in front ; the professor's eye chanced to see what was going on ; the prayer stopped short and the professor dealt with the culprit in angry tones as if an insult had been offered to himself, threatening to have him expelled from the class. A fellow-student rose and asked leave to interpose ; he said that while no one could justify the foolish act he felt sure it was unpremeditated, and, the offender being a young and promising student, the class would be greatly pleased if Professor Thomson could pardon the misconduct. A murmured assent was given by the class and the pardon asked was granted. Things then went on quietly, but the class learned that prayer was not considered by the professor of Natural Philosophy as a mere form, but an act of devotion.

An amusing incident occurred one day illustrative of the professor's inability to credit a student with error. During lecture two students were despatched with an electrometer to the top of the tower of the old College to take some observations. On returning they made their report. It was that the result was negative when positive was expected, or positive when negative was expected. Which it was does not matter. The professor was nonplussed, and the remainder of the lecture hour was spent in endeavouring to solve the mystery. Next morning he stated that he had spent the night endeavouring to do so without success. He propounded many ingenious theories, examined each in turn and disposed of all as untenable. Amongst other suggestions he said that it occurred to

him that the phenomenon might be explained by the locomotives in the St. Rollox Goods Yard blowing off steam, but he had to reject this as the distance was too great and the volume of steam too small. The time was not wasted, as the students learned how problems ought to be handled. On the third morning he appeared radiant. "Gentlemen, I have it now; they turned the instrument upside down." It was the last thing that occurred to him that a student in the Natural Philosophy Class in the University of Glasgow could do so stupid a thing.

His inability to see what was obvious to the dullest in his class was sometimes amusing. He had spent some time in explaining the construction and working of a new marine electrometer which he had designed. "Then, gentlemen, I sent it upon a sea voyage." Everyone pricked up his ears and was greatly amused when he added, "I sent M'Farlane—his assistant—with it in a steamboat on a voyage from the Broomielaw to Dumbarton." He added, quite simply and as reporting a scientific phenomenon, "But what seems strange and what I am unable to explain is that M'Farlane found that the electrometer worked better in the steward's cabin than in any other part of the vessel." This was received with uproarious laughter, some students almost falling off the benches in convulsions. The professor looked round in astonishment at M'Farlane standing like a statue at the other end of the platform. Every student believed, rightly or wrongly, that M'Farlane was not averse to a little of what the steward's cabin could provide, and instantly divined the reason why the electrometer worked better in that part of the vessel than elsewhere, but the professor was not in the secret and this explanation never occurred to him.

Lord Kelvin had strong views regarding the superiority of the metric over the British system of weights and measures, but this is one of the few matters in which he did not carry his students with him. I think that the majority of them were not persuaded of the advantages which he attributed to the metric system and this was

the view of his colleague, Professor Macquorn Rankine, as expressed in his ballad, " The Three-Foot Rule."

Some talk of millimetres, and some of kilogrammes,
And some of decilitres, to measure beer and drams ;
But I'm a British Workman, too old to go to school ;
So by pounds I'll eat, and by quarts I'll drink, and I'll work by my three-foot rule.

A party of astronomers went measuring of the earth,
And forty million metres they took to be it's girth ;
Five hundred million inches, though, go through from pole to pole ;
So let's stick to inches, feet, and yards, and the good old three-foot rule.

THE PHYSICAL LABORATORY

Lord Kelvin's laboratory, or experimental room as it was called, was an entirely new departure, and he used to tell us that it was the earliest of the kind in Great Britain. The apparatus belonging to the department was used for the purpose of illustrating the lectures of the professor. The Physical laboratory was intended for what is now termed research. Professor Thomson found that it was essential for the investigations in which he was engaged to have certain data and these could be obtained only by experiment. It was to obtain such data that the laboratory was set up under the authority of the Faculty and not as a systematic teaching laboratory.

It is perhaps beyond the scope of a University to supply apparatus and material for research by a professor on his own account ; but the Faculty were desirous of assisting their professor and granted him such accommodation as was available and made him a grant towards the cost of apparatus and material, the balance being provided by himself.

The Faculty were proud of their colleague and continued to assist him in every way possible. Professor Thomson, on the other hand, was proud of the University and felt grateful for the assistance it had rendered to him ; and when he began to reap the pecuniary reward of his investigations and inventions he placed a large sum

at the disposal of the University " for promoting the cultivation of experimental science in Glasgow College."

From an early date Professor Thomson associated some of his students with him in laboratory work. One of these when I entered the University was J. B. Russell, who accompanied him on the " Agamemnon " in 1858 and assisted in the laying of the first Atlantic telegraph cable. When I was a student in the Natural Philosophy class there would be about a dozen or twenty of us who worked in the laboratory. The staff then consisted of the professor himself, M'Farlane, his private assistant, Tatlock, a laboratory attendant, and the students. The latter worked as they found convenient, but generally each from two to four hours a day.

As already mentioned, the Natural Philosophy class-room occupied the first floor and second or attic floor of the western division of the north side of the inner quadrangle and the Apparatus room adjoined on the first floor of the building on the west side of the quadrangle and above the Blackstone room. The laboratory was on the ground floor under the west end of the class-room. It comprised (1) the room in the corner building under the Professor's retiring room, (2) the two rooms under the class room, that is the " James Watt room," and the adjoining room occupied by the galvanic battery, and (3) in later years the Blackstone room when it ceased to be used for examination purposes. From the beginning Professor Thomson had the use of the tower, which was approached through the Apparatus room and was convenient for various experiments, particularly when a long perpendicular drop was required, and he likewise had possession of certain of the rooms in the tower. Students worked in the tower and tower rooms and in the Apparatus room as well as in the laboratory.

Lord Kelvin sometimes spoke of the lower part of the laboratory as having been an old wine-cellar, and others, improving upon this, have called it an old coal-cellar, and have stated that the students suffered from the coal dust. For the latter statement there is no foundation, and I speak with certainty, as I was a student in the

Physical laboratory in the years 1862 and 1863, and was familiar with the place both before and after that time. Coals may have been kept in the Watt room ; but if so this was only temporarily, and when the room was handed over to Professor Thomson there was neither coal nor coal dust in it.

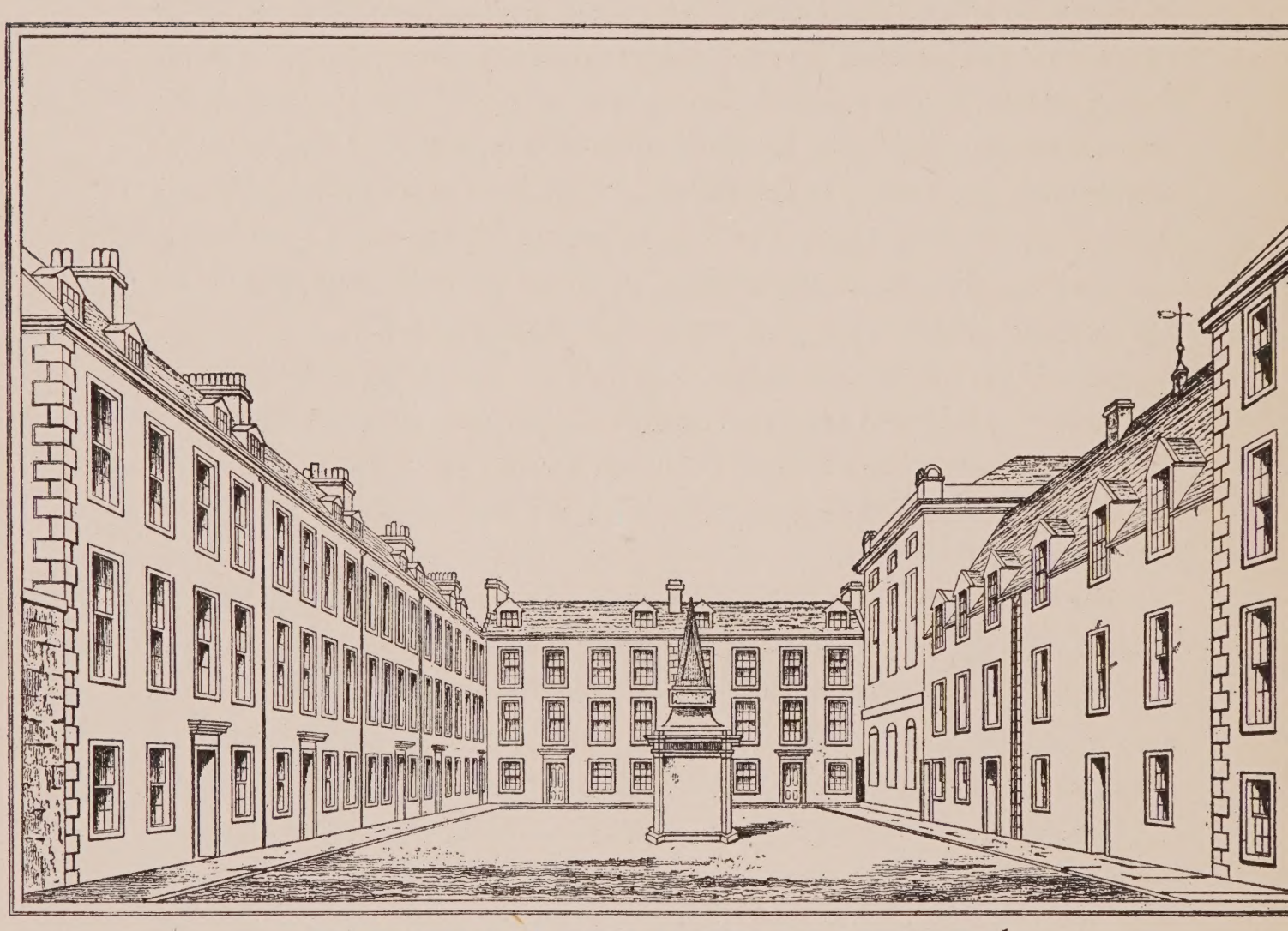
Lord Kelvin's description of the place as " a deserted wine cellar of an old professorial house " is, I think, correct. Why a wine cellar should have been there is probably to be explained by the use of the Janitor's house as a tavern and as a club-room for professors. As stated in the *College of Sydney* the *Cella Vinaria* was outside the Janitor's house and was reached by the back door under the piazza. The Watt room was only a few yards distant, and there seems to be little doubt that it was the place alluded to.

The Watt room was small, but it was suited for experimental work, as it had been for practical and experimental work in Watt's time. The room to the east occupied by the galvanic battery was similar and the room to the west under the Professor's retiring room was also similar.

The laboratory was not an ideal one judged by the standard of to-day, but it was suitable, and a great volume of valuable work, much of it of a delicate description, was done in it. Things were less elaborate then than now. When I was a student Professor Thomson was much interested in spinning discs and the gyroscope, and its modification the gyrostat which he designed. Many experiments were made in the laboratory and also in the class-room. The available space in the latter for unwinding the cord of the gyroscope was too small, but the difficulty was readily overcome. A weight was attached to the end of the cord, and dropped over the window into the Professors' court, and gravity did the rest and did it efficiently.

Although the Physical laboratory has been called a cellar it was not so in the ordinary sense of a basement or being under the ground level. It was on the ground floor on the same level as the class-rooms of Moral Philosophy and Logic, and the Blackstone

room, the latter of which, as I have said, was latterly incorporated with the laboratory. The windows were small, but were sufficient, and corresponded with those in the Moral Philosophy class-room and in the cosy retiring-room of Professor Fleming before referred to. The laboratory was at a considerable distance from the public street,



THE PROFESSORS' COURT AS SEEN FROM THE WEST.[1]

and there was no question of vibration or of electrical disturbance in those days. It was very convenient for the professor, being only forty or fifty yards from his house, No. 2 in the Professors' Court.

[1] The building to the right is the north side of the old College. The central portion of this building is that erected by Dr. Strang in 1632. The portion to the extreme right is part of the building of 1656 extending southwards to the Tower. The portion to the left is the Hamilton building of 1811.

The laboratory, as I have explained, was not intended for training students in the use of apparatus and in the methods of investigation. It was for the research work of the professor himself, and his students worked as his assistants. He gave no instructions regarding the work to be done or how it was to be carried out. This was wholly in the hands of M'Farlane. The professor told M'Farlane what was wanted and how he wished the investigation to be carried out and left the rest to him. M'Farlane distributed the work amongst the students according to their ability, but little instruction was given as to method or manipulation. He, however, could always be consulted; he was most ready to give assistance, and his directions were clear and easy to follow. The professor often came in to see what we were doing and what progress we were making. He would sometimes assist, taking part as if he was one of ourselves, often explaining what he had in view and discussing the problems involved. He had none of the air or manner of a superior, but treated us as if we had been Faradays or Joules. When the investigation was

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The two windows and door on the right hand side of the central building belonged to rooms which formed part of the Physical laboratory. The westmost of these was the James Watt room. The windows to the left in that building are those of the retiring room of the Professor of Moral Philosophy and of the Moral Philosophy class-room.

The windows in the middle storey above the Physical laboratory and above part of the Moral Philosophy class-room and the corresponding windows in the attic were those of the Natural Philosophy class-room. The window immediately above that of the James Watt room was the one from which the weight for unwinding the gyrostat was dropped, and from this window there projected a long slender rod connected with an apparatus for measuring atmospheric electricity. This rod Professor Fleming referred to as " William Thomson's fishing wand."

The single window on the ground floor in the building on the right hand side of the picture belonged to a room which formed part of the Physical laboratory, and was connected internally by a door with the James Watt room. The window above was that of the retiring room of the Professor of Natural Philosophy. The uppermost window belonged to the Civil Engineering department.

The houses on the left hand or north side were Nos. 3 to 7 of the Professors' Court and those at the end of the picture were Nos. 8 and 9. Professor William Thomson's house was No. 2, which is not shown in the picture, but the rustic quoins appearing at the edge of the picture form the corner of that house.

completed the results were handed in and were worked up either by M'Farlane or by a student. William Stewart, afterwards Professor of Biblical Criticism and Clerk of Senate, took his turn in the laboratory when a student in the Natural Philosophy class. He then passed through the Divinity Hall and became a parish minister. Shortly after his appointment as professor he was sitting in the Senate room when Sir William Thomson came in, and after shaking hands said: "Have you got a chair?" "Yes," was the reply. "What is it?" "Biblical Criticism." "Oh, then you'll have plenty of time now to work up those results which were unfinished when you left the laboratory."

Professor Thomson insisted on great care and exactness in experiment. When explaining Coulomb's law of electric force he pointed out that much confusion had arisen regarding it, particularly on the part of Sir William Snow Harris, as the result of his ignorance in experimenting. While Professor Thomson insisted on great exactness it seemed to me that he might have difficulty in observing his own rules, as he was occasionally somewhat impatient. One day something went wrong with a piece of apparatus. He set to work to ascertain what was the matter, and was in such a hurry that it looked as if he would tear it to bits. His brother James Thomson, Professor of Engineering at Belfast, happening to be in the room came forward and asked to be allowed to undertake the work. William at once gave way. James took a chair beside the apparatus, slowly took it to pieces part by part, laying each carefully aside, and worked away until he found the flaw, adjusted it, and then methodically replaced each piece. William would have done the work in one-tenth of the time, but I doubt whether it would have been so well done, and his method might only have produced greater mischief. On the other hand he never had any difficulty in handling instruments of the greatest delicacy.

James White the optician and philosophical instrument maker was a frequent visitor to the laboratory. He constructed the delicate instruments which Professor Thomson invented, and the latter in

the lecture room often spoke of and praised the excellence and exactness of White's work. While White was no doubt a most skilful mechanic, he had further a singular aptitude in grasping Thomson's ideas and giving them practical shape. This early association in later days brought into existence the firm " Kelvin and White."

We heard a great deal about Professor Helmholtz of Berlin in the lecture-room, and one day we had a visit from him in the laboratory.

My bench-fellow in the class-room was Friedrich Trendelenburg, a son of Professor Adolf Trendelenburg of Berlin. I then thought that it had been on the recommendation of Professor Helmholtz that he had become a student in this class, but I now know that he came to Scotland at the suggestion of Professor Allen Thomson to study Anatomy under him and if possible Surgery under Lister, and that he lived in the Professor's family during his stay of two years. Allen Thomson was an old friend of his father Professor Trendelenburg, and his uncle Ferdinand Becker, and had known them since his own student days in Berlin. Friedrich Trendelenburg, I believe, attended the Natural Philosophy class merely for general culture. He spoke English well, and gave me much information regarding German universities and the system of German education. He subsequently became Professor of Surgery in the University of Leipzig and a man of European reputation.

One of Lord Kelvin's most prized possessions was his Green Book. In early life he started a large note book with a green cover which he carried in a specially made pocket in his coat. That Green Book was followed by a succession of others, and each new coat had a special pocket for the Green Book, and great was the trouble if the Green Book should be mislaid. A few years before his death he was travelling from London to Glasgow, but the train instead of arriving at 9 o'clock in the evening did not do so until one or two in the morning. A friend who met him asked whether he had not found

the delay wearisome. "Oh, no," he said, "I just took out my Green Book and solved a problem I have had in my mind for forty years."

Lord Kelvin often referred to his early days in the old College. In one of his addresses he says, "I remember well, when in 1839, the old Natural Philosophy class-room and apparatus room (no physical laboratory then) was almost an earthly paradise to my youthful mind."[1] I asked him one day whether he remembered the meeting of the British Association at Glasgow in 1840, in which his father and Professor J. P. Nichol took part, and whose sectional meetings were held in the class-rooms of the old College. He replied that he remembered it quite well. I then asked whether he recollected that the Association had an exhibition of models, instruments and the like in the Monteith Rooms, Buchanan Street. He said he did, and had gone through it and examined the exhibits. I asked whether he recollected Ponton's galvanic telegraph, which had been constructed by Mr. John Dunn, Philosophical Instrument Maker in Buchanan Street. He said he must have seen it, but he could not specially recollect it. I explained that I had been going over some papers connected with the meeting of the Association a few days before and I found that Mr. Dunn had read a paper before the Association on this telegraphic instrument, and that he had prepared a printed Explanation which was handed to visitors so that they might understand the instrument, and I thought that it was highly probable that when he visited the Exhibition he would get the paper. He said that this was quite likely, but he could not recollect the circumstance. I said that I was struck by the concluding paragraph of the Explanation: "The further improvement of this instrument, and a more familiar acquaintance with its use, may ultimately lead to connections being made between the most distant countries of the world for the transmission of intelligence; and posterity may perhaps witness the receipt of news from India by a galvanic telegraph in as many minutes as there are weeks now

[1] *Lord Kelvin*, p. 71, Glasgow 1899, 4to.

occupied in the conveyance of a despatch,"[1] and that it seemed somewhat remarkable that the expectation of Mr. Dunn should within twenty years be realised in Glasgow, and by a visitor to the Exhibition. Lord Kelvin said that it certainly was very interesting and asked me for a copy of the paragraph which I sent to him.

How close Professor Thomson considered his association with the University of Glasgow is curiously illustrated by the grant of arms made to him upon his being elevated to the peerage in 1892. He took his title from the River Kelvin which flows round the base of Gilmorehill, and a Glasgow student of arts with a marine voltmeter in his hands stands as one of the supporters.

The arms are thus officially described:—Argent, a stag's head caboshed, gules on a chief, azure, a thunderbolt, proper, winged or, between two spur revels of the first. Crest: A cubit arm erect, vested, azure, cuffed argent, the hand grasping five ears of rye, proper. Supporters: On the dexter side a student of the University of Glasgow, habited, holding in his dexter hand a marine

[1] *Description of Mr. Ponton's Galvanic Telegraph, constructed by John Dunn, Optician and Philosophical Instrument Maker, Glasgow . . . & Edinburgh . . .* (Glasgow, September 1840), 8vo. In the paper read before the Section the instrument was styled an "Electro-magnetic Telegraph."

Mungo Ponton was a Writer to the Signet in Edinburgh, and is now chiefly remembered by his inventions and discoveries in connection with photography.

voltmeter, all proper; and on the sinister side a sailor, habited, holding in the dexter hand a coil, the rope passing through the sinister, and suspended therefrom a sinker of a sounding-machine, also all proper. Motto: (Over the crest) Honesty without fear.

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